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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/669,047	09/23/2003	Paul DuBois	LSTC-001	3997

37804 7590 09/18/2006

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EXAMINER	
STEVENS, THOMAS H	

ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 09/18/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/669,047	DUBOIS ET AL.	
	Examiner	Art Unit	
	Thomas H. Stevens	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09/23/2003 & 07/26/2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *13-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *13-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *12/13/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-12 were cancelled.

2. Claims 13-26 were added and examined.

Information Disclosure Statement

3. The information disclosure statement filed 12/31/2003 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered.

4. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609.04(a) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 13-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kakavas-P.A., "Evaluation of the Derivatives of the Strain Energy Function with Respect to Strain Invariants for Carbon-Black-Filled EPDM (hereafter, Kakavas) in view of Gallagher et al., "An Efficient 3-D Visualization Technique for Finite Element Models and Other Coarse Volumes" (hereafter, Gallagher) and in further view Wong et al., "Combined Finite Element-Modal Solution of Three-Dimensional Eddy Current Problems" (hereafter Wong).

Kakavas teaches an experimentation of mechanical properties using the Ogden equation and finite element (FEM) with strain-stress curves (pg.1592, figure 1) of rubber-like material (pg.1589, left column, lines 27-29); but fails to teach gradients, lookup tables and eigensolutions.

Gallagher teaches efficient 3D FEM modeling techniques (title) with lookup tables(pg. 187, left column, line 3) with the gradient (pg.186, left column, 1st paragraph, line 6), while Wong teaches a combined FEM of 3D eddy current problems while solving for a solving eigensolution (pg. 2685, 3rd paragraph).

All three pieces of art are analogous since they all teach eigenvalues. Therefore it would have been obvious to one having ordinary skill in the art at the time of invention was made to utilize the bi-cubic polynomials of Gallagher and the modal analysis of Wong in the strain invariants of Kakavas because Gallagher teaches a method of reducing the computational and display bandwidth of general 3-D solid visualization problems (Gallagher: pg. 192, conclusion, 2nd paragraph). Wong teaches methods which are completely stable (pg. 2687, conclusion).

Claim 13. A method for simulating structural responses of a rubber-like material (Kakavas: pg.1589, left column, lines 27-29) in finite element analysis, the method comprising: defining a plurality of elements and a strain-stress curve (Kakavas: pg.1592, figure 1) to represent the rubber-like material (Kakavas: pg.1589, left column, lines 27-29); iteratively calculating a plurality of stress function (Kakavas: pg.1590,

equation 11) values (Kakavas: pg.1590, equation 11) at a plurality of corresponding stretch ratios of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29) and associated stress values (points on the curve, Kakavas: pg.1592, figure 1) defined in the strain-stress curve (Kakavas: pg.1592, figure 1); storing the plurality of stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11) into a stress function (Kakavas: pg.1590, equation 11) lookup table; obtaining a set of principal stretches by solving eigensolution (Wong: pg. 2685, 3rd paragraph)of a deformation gradient (Gallagher: pg.186, left column, 1st paragraph, line 6) tensor at each integration point of each of the elements; determining principal stresses in principal directions from the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) in accordance with the principal stretches; and transforming the principal stresses into global coordinate system (property of FEM, well-known).

Claim 14. The method of claim 13, wherein the strain-stress curve (Kakavas: pg.1592, figure 1) is obtained from a physical experiment of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29) under a uni-axial (Kakavas: 1591 "Like Materials Subject to Uniaxial Tension") loading condition.

Claim 15. The method of claim 13, wherein the stretch ratio is a ratio between deformed length divided by original length of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29) in one direction.

Claim 16. The method of claim 1 5, wherein the stretch ratio is equal to strain of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29) minus 1.

Claim 17. The method of claim 13, wherein the strain has a range between -0.8 and 1.2(manipulation of mathematical concepts).

Claim 18. The method of claim 13, said iteratively calculating the plurality of stress function values further includes: (a) calculating a function value by multiplying an initial stretch ratio with the associated stress value at lambda minus 1; (manipulation of mathematical concepts) (b) initializing an old stretch ratio old with the initial stretch ratio; (c) calculating a new stretch ratio new as an inverse of square root of the old stretch ratio old; (manipulation of mathematical concepts) (d) when absolute value of is less than or equal to a predetermined threshold, assigning the function value to a particular one of the stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11) corresponding to the initial stretch ratio (e) otherwise,
adjusting the function value by adding another term, wherein another term is calculated by multiplying the new stretch ratio new with the associated
stress value at new -1(manipulation of mathematical concepts); assigning the new stretch ratio new to the old stretch ratio old (manipulation of mathematical concepts); and repeating (c), (d) and (e), until (d) has been satisfied.

Claim 19. The method of claim 18, wherein the predetermined threshold is 0.01 (manipulation of mathematical concepts) .

Claim 20. The method of claim 13, said determining principal stresses in principal directions from the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) further includes interpolating the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) to obtain the principal stresses at the principal stretches.

Claim 21 . A computer program product including a computer usable medium having computer readable code embodied in the medium for causing an application module to execute on a computer for simulating structural responses of a rubber-like material, the computer program product comprising: program code for defining a plurality of elements and a strain-stress curve (Kakavas: pg.1592, figure 1)to represent the rubber-like material; program code for iteratively calculating a plurality of stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11)at a plurality of corresponding stretch ratios of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29) and associated stress values (points on the curve, Kakavas: pg.1592, figure 1)defined in the strain-stress curve Kakavas: pg.1592, figure 1); program code for storing the plurality of stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11)into a stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3); program code for obtaining a set of principal stretches by solving eigensolution (Wong: pg. 2685, 3rd

paragraph)of a deformation gradient (Gallagher: pg.186, left column, 1st paragraph, line 6) tensor at each integration point of each of the elements; program code for determining principal stresses in principal directions from the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) in accordance with the principal stretches; and program code for transforming the principal stresses into global coordinate system.

Claim 22. The computer program product of claim 21 , said program code for iteratively calculating the plurality of stress function (Kakavas: pg.1590, equation 11) values further includes: (a) program code for calculating a function value by multiplying an initial stretch ratio with the associated stress value at lambda –1 (manipulation of mathematical concepts); (b) program code for initializing an old stretch ratio old with the initial stretch ratio; (c) program code for calculating a new stretch ratio new as an inverse of square root of the old stretch ratio old; (d) when absolute value of new-1 is less than or equal to a predetermined threshold, (manipulation of mathematical concepts) program code for assigning the function value to a particular one (manipulation of mathematical concepts) of the stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11) corresponding to the initial stretch ratio; (manipulation of mathematical concepts) (e) otherwise, program code for adjusting the function value by adding another term, wherein another term is calculated by multiplying the new stretch ratio new with the associated stress value at new - 1(manipulation of mathematical concepts); program code for assigning the new stretch

ratio new to the old stretch ratio (manipulation of mathematical concepts); and program code for repeating (c), (d) and (e), until (d) has been satisfied.

Claim 23. The computer program product of claim 21 , said program code for determining principal stresses in principal directions from the stress function (Kakavas: pg.1590, equation 11) lookup (Gallagher: pg. 187, left column, line 3) table further includes program code for interpolating the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) to obtain the principal stresses at the principal stretches.

Claim 24. A system for simulating structural responses of a rubber-like material (Kakavas: pg.1589, left column, lines 27-29) in finite element analysis, the system comprising: an I/0 interface; a communication interface; a secondary memory; a main memory for storing computer readable code for an application module; at least one processor coupled to the main memory, the secondary memory, the 1/0 interface, and the communication interface, said at least one processor executing the computer readable code in the main memory to cause the application module to perform operations of: defining a plurality of elements and a strain-stress curve (Kakavas: pg.1592, figure 1)to represent the rubber-like material; iteratively calculating a plurality of stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11)at a plurality of corresponding stretch ratios of the rubber-like material (Kakavas: pg.1589, left column, lines 27-29)and associated stress values (points on the curve,

Kakavas: pg.1592, figure 1)defined in the strain-stress curve Kakavas: pg.1592, figure 1); storing the plurality of stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11)into a stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3); obtaining a set of principal stretches by solving eigensolution (Wong: pg. 2685, 3rd paragraph)of a deformation gradient (Gallagher: pg.186, left column, 1st paragraph, line 6) tensor at each integration point of each of the elements; determining principal stresses in principal directions from the stress function lookup table (Gallagher: pg. 187, left column, line 3) in accordance with the principal stretches; and transforming the principal stresses into global coordinate system (property of FEM, well-known).

Claim 25. The system of claim 24, said iteratively calculating the plurality of stress function values further includes operations of: (a) calculating a function value by multiplying an initial stretch ratio with the associated stress value at lambda –1 ; (b) initializing an old stretch ratio old with the initial stretch ratio; (c) calculating a new stretch ratio new as an inverse of square root of the old stretch ratio old; (manipulation of mathematical concepts) (d) when absolute value of new-l is less than or equal to a predetermined threshold, assigning the function value to a particular one of the stress function (Kakavas: pg.1590, equation 11) values (Kakavas: pg.1590, equation 11) corresponding to the initial stretch ratio (e) otherwise, adjusting the function value by adding another term, wherein another term is calculated by multiplying the new stretch ratio new with the associated stress value at new -1; assigning the new stretch ratio

new to the old stretch ratio old(manipulation of mathematical concepts); and repeating (c), (d) and (e), until (d) has been satisfied.

Claim 26. The system of claim 24, said determining principal stresses in principal directions from the stress function (Kakavas: pg.1590, equation 11) lookup table (Gallagher: pg. 187, left column, line 3) further includes operations of interpolating the stress function (Kakavas: pg.1590, equation 11) lookup table to obtain the principal stresses at the principal stretches.

Citation to Relevant Prior Art

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- US Patent 3,722,289 teaches detection of dynamic gravitation force gradient fields.
- Peric et al., "Finite-Element Applications to the Non-linear Mechanics of Solids" 1998 Univ of Wales pg. 1595-1574: teaches finite element representations of 3D solid materials.
- MSC Software, Technical Paper 2000 pg.1-60 is a software-based service manual for rubber-like materials.

Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mr. Tom Stevens whose telephone number is 571-272-3715, Monday-Friday (8:00 am- 4:30 pm EST).

If attempts to reach the examiner by telephone are unsuccessful, please contact examiner's supervisor Mr. Paul Rodriguez 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov.. Answers to questions regarding access to the Private PAIR system, contact the Electronic Business Center (EBC) (toll-free (866-217-9197)).

September 8, 2006

TS

9/14/06

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